

QUANTIFICATION OF PRIORITIZED REQUIREMENTS OF STEEL PRODUCT WITH QFD ANALYSIS

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ABSTRACT

It is a customer oriented way to deal with and analyze HOQ implementation focusing on to set up the requirements, priorities, and importance of the design requirements. The customer developed product is found through an investigated worldwide steel product markets and customers. QFD is a powerful tool which is applied to product development organizations, where customers play a critical part in bringing out the product acceptable to them. In this investigation, the product Nut and bolt of MS and high Tensile steel has been taken, and investigated the result for ranking of client's requirements and prioritized design requirements. In light of the findings, it is recommended for enhancing the quality of the product with the critical parameters influencing knowledge that the company should implement to stand against the competition and gain a place in the global market.

KEYWORDS: Customer Oriented, Tensile Steel. & Global Market

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INTRODUCTION

Overview of Indian Steel Industry

The overall steel part has been encountering a testing minute, with grungy steel age down to 1,598 million tons in the year 2015 and surveyed to drop further to 1,545 in the year 2016. With reduced steel costs, creation record has been surveyed to have crumpled from US\$ 2.5 trillion in the year 2011 to just US\$ 1.5 trillion in the year 2015. The diminishment in demand and development of steel in China are in immense part to blame and other world markets anticipate a further 2.9% decrease for the year 2016.

The Indian steel industry, with a production of about 1 mt at the time of independence, has come a long way to reach the production of about 57 Mt in 2006-07. Moreover, the steel industry is showing promising future growth as major players in the industry have announced their plans for significant investments in expanding their capacities. Impressive development of the steel industry with active participation of private sector and integration of India steel industry with the global steel industry has also induced the government to come up with a National Steel Policy in 2005. The National Steel Policy 2005 was recruited with the intention to establish roadmap and framework for the improvement of the steel industry. The policy visualizes steel production to reach at 110 mt by the year 2019-20 with yearly growth rate of 7.3 %.

The global steel market places and organizations need to focus on the necessities of customers and offer them the quality product or services satisfying their total Approaches can be created so as to "guide" the customers to choose among various products.

For competing and surviving in the global steel marketplace, companies have to pay attention to the needs

of customers and offer them quality products or services satisfying their aggregate.

Capturing the Voice of Customer

Approaches can be developed in order to “guide” the customers to choose among different products. “A customer is fulfilled only when they tell that they are pleased. The insight is his/her interpretation of the value received played back against expectations. These expectations. Thus, they require a management system that enables the continuous development of their processes and products. Firms must recognize the pursuit of desirable outcomes through these efforts as their critical management objective. To these ends, numerous firms are altering their business processes from a product-oriented method to a marketing oriented method Lai, 2003 [1]

Quality function deployment is a customer driven device in executing Total Quality Management (TQM). Among numerous TQM methods, QFD chosen to convert customer needs and necessities into technical design requirements by integrating marketing, design engineering, manufacturing, and additional significant functions of an organisation Akao, 2004 [2].

A marketing oriented method prerequisites that the customer satisfaction is the main point of the firm culture. As satisfied consumers make repeat purchases, customer satisfaction is essential for firm’s success. Due to the research by Kotler and Armstrong [3], customer satisfaction depends on product’s performance relative to customer’s expectations

In recent times, Santoset al., [4] outlined 11 benefits emerging from the utilization of QFD, for example, customer-orientated organizations and market-driven products, less design changes, decrease in start-up costs, shorter design cycles and multifunctional cooperation. The QFD’s benefits also comprise “better systematic documentation of engineering knowledge and business operations procedures,” “more competitive pricing due to lower development and startup costs,” “more satisfied customers,” and seven others.

In order to create satisfied customers, first of all, the customer expectations have to be analyzed in order to understand the motives of a purchase, so that customer expectations are built in the product during the new product development stage. After that, different marketing declaration does not require any objective evidence and it can be a declaration made with no reason” Nowacki, [5].

Quality Function Deployment is an idea and mechanism for interpreting the voice of consumers into product features through several phases of product planning, engineering and manufacturing G.L.Nielsen [6]. Until 1972, proper method was not framed for quality control in the product development process. K.L. Martin, and E.Powers [6] developed an efficient quality control method for product development process suitable for every industry

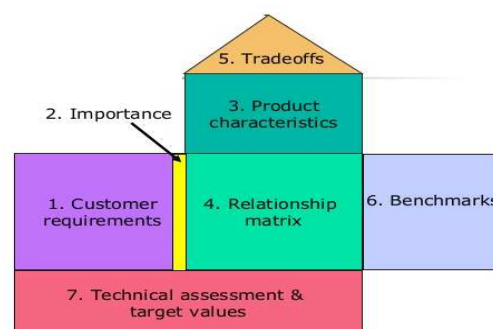


Figure 1: QFD Methodology

METHODOLOGY

QFD in the Steel Industry

QFD is a method for requirements engineering resulting from the quality development in the 1980's. QFD is characterized as "a methodical and customer-focused design approach for identifying and prioritizing customer needs, making an interpretation of these necessities into item/benefit determinations, and following them all through the item acknowledgment prepare" Davis et al [7]. The QFD tool gives a graphical system to deciding client desires. The QFD as a rule will show to the included people how the requirements and desires of the customers are satisfied. These instruments additionally show how the clients' advantages are paralleled with the organizations' advantages. There are six fundamental components of QFD, which are.

- Deciding the customer's requirements (the QFD WHAT)
- Meeting HOW the prerequisites can be accomplished (the QFD HOW) for the clients
- The connection between the requirements and HOW they are to be met
- Target values for the requirements
- Connections between how the prerequisites are to be met
- A quantification of the importance of the requirements

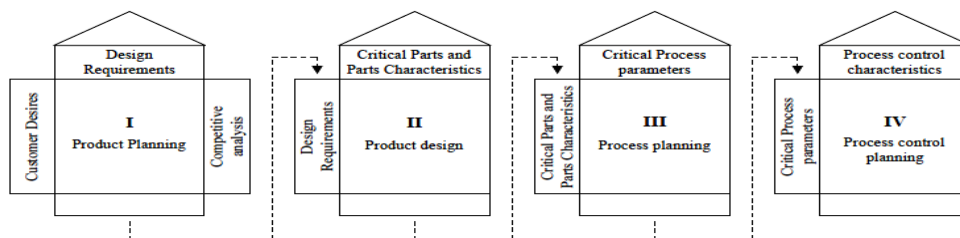


Figure 2

- **Phase I:** Product planning (HoQ)
- **Phase II:** Design deployment (part deployment)
- **Phase III:** Manufacturing planning (process planning)
- **Phase IV:** Production planning (production operations planning) Proponents of this design process generally build a house

Manufacturing of M S and High Tensile Steel Bolts of 10mm to 36 mm

Market Potential of the nut and bolts

The demand of nuts and bolts is affected by the following components

- Transportation industries, Railways, aircraft, wagon, bikes, car, body builders, and so forth.
- Electrical industries like assembling of transformer, electric motors, fans and so forth.
- Construction works, for example, Constructions of bridges, building of different steel structure and so forth.

- Other heavy and light industries, steel and wooden furniture, machine tools, agriculture machinery and applications and so forth.

As different types of MS and High Tensile Steel nuts and bolts are utilized in above areas, the market is demand is just directly proportional to development of these industrial sections.

| S.No | Customer Requirements | Design Requirements |
|------|-----------------------|----------------------------|
| 1 | Robust Features | Chemical Composition |
| 2 | Dimensional Stability | Design and Analysis |
| 3 | Corrosion Stability | Tolerance |
| 4 | Durability | Physical/Material property |
| 5 | Aesthetic look | Mechanical property |
| 6 | Short lead | Quality |
| 7 | Chemical coating | Cycle Time |
| 8 | Cost | Manufacturing Process |
| 9 | Hardness | Temperature /Coolant |
| 10 | Easy to use | Maintenance |

Figure 3: Customer Requirements and Engineering Design Requirements

CONSUMER SATISFACTION RATINGS

Importance to Customer

[8] The QFD group—or, ideally, the concentration gathering—positions every client necessity of allocating it a rating. Numbers 1 through 10 are recorded in the significance to client segment to demonstrate a rating of 1 for slightest imperative and 10 for vital. As such, the more critical the client necessity, the higher the rating.

Significance evaluations speak to the relative significance of every client prerequisite as far as each other. Relegating appraisals to client necessities is at times troublesome, in light of the fact that every individual from the QFD group may accept distinctive prerequisites ought to be positioned higher. The significance rating is helpful for organizing endeavors and settling on exchange of choices.

Target Value

The objective esteem segment is on an indistinguishable scale for the client aggressive evaluation (1 for most exceedingly bad, 5 for best can be utilized). This segment is the place where the QFD group chooses whether they need to keep their item unaltered, enhance the item, or improve the item than the opposition.

Table 1: Customer Requirements, Target Value, and Absolute Weight

| S.NO | Customer Requirements | Importance Rating | Sales Point Rating | Target Value | Scale-up Factor | Absolute Weight |
|------|-----------------------|-------------------|--------------------|--------------|-----------------|-----------------|
| 1 | Robust Features | 5 | 2 | 4 | 1 | 10 |
| 2 | Dimensional Stability | 5 | 1.5 | 5 | 1 | 7.5 |
| 3 | Corrosion Stability | 4 | 1.5 | 5 | 1.33 | 7.98 |
| 4 | Durability | 4 | 1 | 2 | 2 | 8 |
| 5 | Aesthetic look | 2 | 1 | 2 | 2 | 4 |
| 6 | Short lead | 3 | 1 | 3 | 1 | 3 |
| 7 | Chemical coating | 2 | 1 | 2 | 1.66 | 3.32 |
| 8 | Cost | 3 | 1.5 | 3 | 1.66 | 7.47 |
| 9 | Hardness | 3 | 1.5 | 3 | 1.33 | 5.98 |
| 10 | Easy to use | 3 | 1 | 3 | 1.33 | 3.9 |

Scale-up Factor/Development Ratio

The scale-up factor is the proportion of the objective incentive to the item evaluating given in the client focused appraisal. The higher the number, the more effort is required. Here, the essential thought is the level the product is at now and what the objective rating is and choosing whether the identification is within. Infrequently there isn't a decision on account of the troubles in finishing the objective.

Subsequently, The Sales Point tells the QFD group how well a customer requirement will offer. The aim here is to advance the best customer requirement and any outstanding client prerequisites that will help in the offer of the item.

The Sales Point

Sales Point is controlled by recognizing the client necessities that will help the offer of the item. For example, a streamlined look could enable the offer of the handlebar to stem, so the business point is given an estimation of 1.5. On the otherhand that a client prerequisite won't help the offer of the item, the business point is given an estimation of 1.

Absolute Weight

Absolute weight = Importance to customer \times Scale-up factor \times Sales Point

Table 2: Interrelationship Matrix of House of Quality

Interrelationship Between Design Requirements (Correlation matrix) HOWs vs HOWs

Design Requirement (HOWs)

WHATs vs HOWs

Relation between Customer Requirements Design Requirements

+9 Strong
+3 Medium
+1 Weak

Technical Parameters
M8 and High Tensile Steel
Bolt of 10 mm to 16 mm (10)

| Customer Requirement (What) | Chemical Composition | Design and Analysis | Tolerance | Physical /Material Property | Mechanical property | Quality | Cycle Time | Manufacturing Process | Temperature /Coolant | Maintenance | Own company | Competitor form 1 | Competitor form 2 | Prioritized Customer Requirements |
|----------------------------------|----------------------|---------------------|-----------|-----------------------------|---------------------|---------|------------|-----------------------|----------------------|-------------|-------------|-------------------|-------------------|-----------------------------------|
| Robust Features | 3 | 1 | 9 | 3 | 1 | 3 | 1 | 1 | 1 | 5 | 4 | 4 | 5 | 2 |
| Dimensional Stability | 3 | 9 | 9 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 5 | 1.5 |
| Corrosion Stability | 9 | 3 | 3 | 3 | 9 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 4 | 1.5 |
| Durability | 3 | 9 | 3 | 3 | 9 | 3 | 9 | 1 | 1 | 3 | 2 | 5 | 4 | 1 |
| Aesthetic look | 3 | 3 | 9 | 1 | 3 | 3 | 9 | 3 | 3 | 4 | 4 | 5 | 2 | 1 |
| Short lead | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 9 | 4 | 3 | 4 | 3 | 1 |
| Chemical coating | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 4 | 3 | 4 | 2 | 1 |
| Cost | 3 | 9 | 3 | 3 | 9 | 9 | 3 | 3 | 3 | 5 | 4 | 4 | 3 | 1.5 |
| Hardness | 9 | 9 | 1 | 9 | 9 | 9 | 3 | 9 | 3 | 4 | 5 | 3 | 3 | 1.5 |
| Easy to use | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 3 | 9 | 5 | 3 | 4 | 3 | 1 |
| Technical Competitive Assessment | Our Product | 5 | 4 | 5 | 2 | 4 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| | A's Product | 3 | 4 | 4 | 3 | 3 | 5 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| | B's Product | 4 | 4 | 3 | 2 | 3 | 4 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| Degree Of Technical Difficulty | | 7 | 4 | 9 | 6 | 5 | 8 | 3 | 2 | 7 | 4 | 4 | 4 | 4 |
| Target Value | | 0 | 0 | 5 | 4 | 4 | 5 | 5 | 3 | 0 | 0 | 0 | 0 | 0 |
| Absolute weight percent | | 102 | 150 | 83 | 138 | 98 | 100 | 152 | 83 | 69 | 113 | 113 | 113 | 113 |
| Relative weight percent | | 188 | 293 | 128 | 231 | 183 | 203 | 294 | 148 | 150 | 178 | 178 | 178 | 178 |
| Rank | | 5 | 2 | 10 | 3 | 6 | 4 | 1 | 8 | 9 | 7 | 7 | 7 | 7 |

Table 3: Top Ranked Customer Requirements Absolute Weight

| Rank | Customer Requirements | S.NO |
|------|-----------------------|------|
| 1 | Robust Features | 1 |
| 2 | Durability | 4 |
| 3 | Corrosion Stability | 3 |
| 4 | Dimensional Stability | 2 |
| 5 | Cost | 8 |
| 6 | Hardness | 9 |
| 7 | Aesthetic look | 5 |
| 8 | Easy to use | 10 |
| 9 | Chemical coating | 7 |
| 10 | Short lead | 6 |

Table 4: Top Ranked Design Requirements Relative Weight Percent

| Rank | Design Requirements | S.NO |
|------|----------------------------|------|
| 1 | Cycle Time | 8 |
| 2 | Design and Analysis | 2 |
| 3 | Physical/Material Property | 4 |
| 4 | Quality | 7 |
| 5 | Chemical Composition | 1 |
| 6 | Mechanical Property | 5 |
| 7 | Maintenance | 10 |
| 8 | Manufacturing Process | 8 |
| 9 | Temperature /Coolant | 9 |
| 10 | Tolerance | 3 |

ANALYSES

As indicated by [9] Customer satisfaction for quality product, Investigation House of Quality for MS and High Tensile nuts and bolts have been displayed (Figure 3). The working of The HOQ covered the following stages.

The importance of demands of customer has been grouped.

[10] – [13] the size of the significance of possessing action at customer with his requirements has been analyzed. Satisfied request of the customer has been allotted to relating parameters of the product. Degree of technical difficulty, the investigation of estimation accomplished by the customer is shown. Comparison between the company's product and competitive product, in view of technical parameters shown in Table 2 of Steel nut and bolt of 16mm.

Prioritized Customer Requirement (Target value, Scale-up factor, Sales point, absolute weight and percent) are estimated Table 2.

CONCLUSIONS

The Absolute weight rating for each Design Requirement is determined by taking the dot product of the column in the relationship matrix and column weight for importance to customer the greater value of absolute weight rating for Design Requirement (Cycle Time - overall manufacturing time) indicated that Steel Nuts and Bolts is **152** in the Table 2.

The Relative weight for each Design Requirement is determined by taking dot product of the column in the relationship matrix for absolute weight in the Prioritized Customer Requirement for Design requirement (Cycle Time - overall manufacturing time) for MS and High Tensile Steel Nuts and Bolts rating **294** in the table 2.

Investigation reveals that the House of Quality recognizes the basic Engineering Design Requirements that requires a change.

The Top Ranking of the Customer Requirement (**Robust Design, Durability, Corrosion Stability, Dimensional Stability and Cost**) and

Top Ranking of Design Requirement (**Cycle Time, Design and Analysis, Physical/Material Property, Quality and Chemical Composition**) are Tabulated in Table 3 and Table 4

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